

# Report of the 700 MHz Technical Working Group

October 23, 2006

## 1. Introduction

### Background

The Federal Communications Commission (“FCC” or “Commission”) is currently conducting a number of proceedings that will have significant impact on both public safety and commercial uses of the Upper 700 MHz band – a portion of the radio spectrum that exhibits superior technical and economic performance in wireless communications systems that are vital to the public. One of the proceedings was initiated by the Commission’s adoption of a *Notice of Proposed Rule Making* on March 17, 2006. This proceeding, referred to herein as the *Public Safety Notice*, sought comment on the potential introduction of broadband communications technology in the portion of the Upper 700 MHz band allocated for public safety use.

In the *Public Safety Notice*, the Commission asked for comment on three specific proposals for accommodating broadband within the public safety allocation. These three proposals were submitted by the National Public Safety Telecommunications Council (“NPSTC”), Motorola, and Lucent Technologies. In response to the *Public Safety Notice*, a new consortium of stakeholders filed comments proposing a fourth approach they called the Broadband Optimization Plan (“BOP” or, simply, “Optimization Plan”). The BOP proposed the “rebanding” of the Upper 700 MHz band to advance a number of important Commission goals including promoting and improving public safety communications, facilitating the rollout of broadband communications across the country, and increasing the efficiency with which the increasingly scarce spectrum resource is utilized.

While the potential long-term benefits of the BOP were widely recognized and many public safety and commercial entities supported consideration of the plan, concerns were raised in three principal areas. *First*, concerns were expressed regarding the time needed for consideration of the plan by the Commission. *Second*, concerns were expressed regarding the movement of certain narrowband channels that would be necessitated by the proposed Optimization Plan. These concerns centered mainly on the costs of reprogramming existing 700/800 MHz radios to allow them to operate at a different location within the public safety allocation. *Third*, concerns were raised regarding the implementation of the BOP in states bordering Canada.

### The 700 MHz Technical Working Group

Because of the potential long-term benefits of the BOP, the broad support for the notion that the Optimization Plan at least be considered, and the need to address expeditiously the technical issues that had been raised concerning the plan, an open, voluntary and informal group of specialists from public safety entities, equipment vendors, and licensees in the band was assembled in July 2006. The informal group was called the 700 MHz Technical Working Group (“Technical Working Group” or “TWG”). The purpose of the Technical Working Group was to provide factual information and, to the extent possible, develop a consensus as to how the

technical issues associated with reprogramming the existing public safety radios and implementing the plan in the Canadian border region might be resolved in an expeditious fashion.

Since its founding, the Technical Working Group has held a total of five in-person and telephonic meetings including an “outreach” meeting with Canadian officials regarding border issues. The meetings were regularly attended by representatives from NPSTC, the State of New York (“New York State”), Motorola, M/A-COM, Pegasus Communications Corp. (“Pegasus”), and Access Spectrum, LLC (“ASL”), and representatives from APCO, IACP and IAFC were kept abreast of the TWG’s progress. This report contains the results of the deliberations of the Technical Working Group and contains meaningful contributions from all of the parties participating in the TWG.

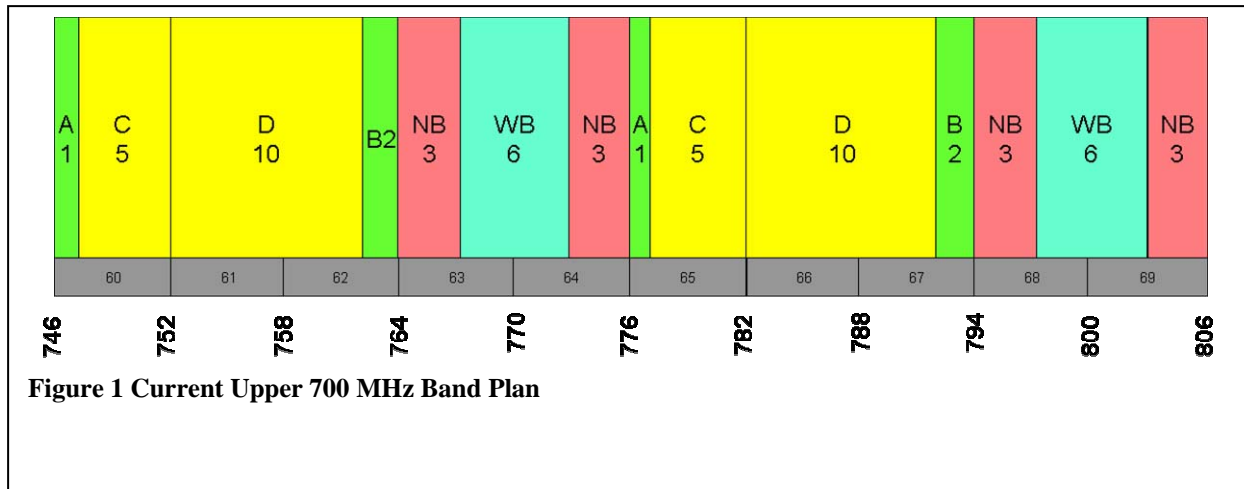
### Organization of the Balance of the Report

The balance of this report is divided into five sections. Section 2 provides a more detailed description of the Optimization Plan. Section 3 addresses the technical and other implementation issues associated with the migration of currently deployed narrowband public safety radios/systems to the proposed new location in the Public Safety allocation. Section 4 deals with the issues associated with implementation of the plan in the Canadian border region and with the closely related issues associated with renegotiation of the current cross-border agreement with Canada. Section 4 also addresses another closely related topic – the impact of the plan on currently planned public safety deployments in the 700 MHz band with particular focus on the rollout of the New York State Public Safety System. Section 5 describes the status of the outreach efforts made by the Technical Working Group to promote understanding of the Optimization Plan and thereby facilitate support for the plan. Finally, Section 6 provides a brief summary and statement of the report’s conclusions.

## **2. Description of the Broadband Optimization Plan**

### The Current Upper 700 MHz Band Plan

The current Upper 700 MHz band plan encompasses the 60 MHz of spectrum overlaying UHF television channels 60 – 69 (746 – 806 MHz). The current band plan is illustrated in Figure 1. Under this existing plan, public safety is allocated a total of 24 MHz of spectrum consisting of UHF television channels 63 – 64 and 68 – 69. Of the total public safety allocation, 6 MHz of paired spectrum (i.e., 12 MHz total) is devoted to narrowband voice services and 6 MHz of paired spectrum is devoted to wideband systems. As shown in Figure 1, the 6 MHz wideband allocations are contiguous and contained in channels 63 – 64 and channels 68 – 69. The 6 MHz of paired, narrowband spectrum is divided into two non-contiguous blocks of 3 MHz each and reside on either side of the wideband allocations. If the existing wideband allocation were used for broadband systems instead, the actual amount of spectrum available for such use would be reduced to 4 MHz paired because of the need to employ a 1 MHz guard band between the broadband system and the narrowband systems on either side.



### The Broadband Optimization Plan

The Broadband Optimization Plan, which was the subject of the Technical Working Group's deliberations, consists of three parts or steps:

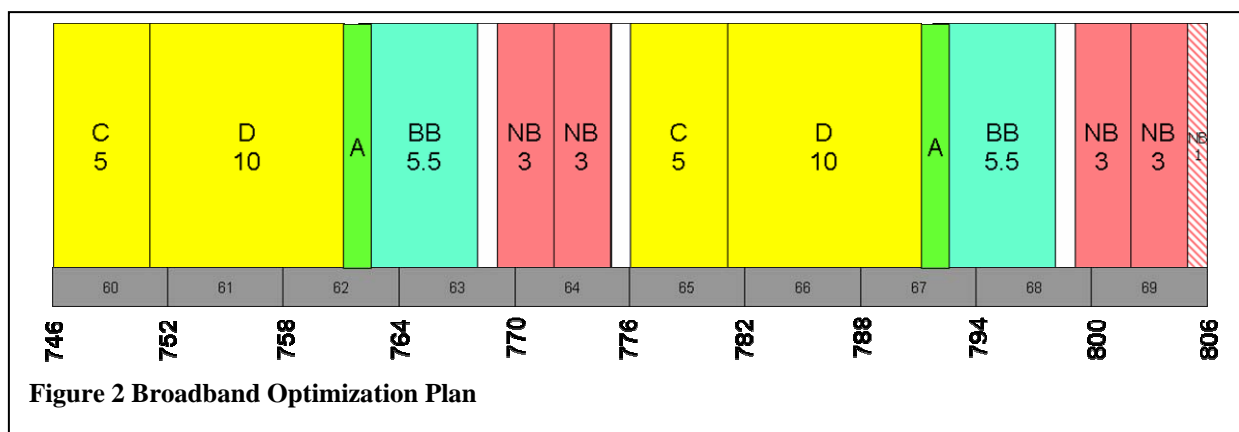
*First*, the narrowband spectrum would be consolidated at the top or upper end of the public safety allocation by relocating the lower 3 MHz of paired narrowband spectrum and making it contiguous with the upper 3 MHz of paired spectrum.

*Second*, it would add spectrum to the public safety segment by reallocating 3 of the 4 MHz that is currently allocated to the B Block. This reallocation would produce a total public safety allocation of 27 MHz (versus the existing 24 MHz) paired with the additional spectrum being available for use as internal guard bands for mitigation of interference by public safety and/or commercial broadband systems to public safety narrowband/wideband systems.

*Third*, the remaining 1 MHz of B Block spectrum would be reallocated to the A Block which would be moved and made contiguous with the lower edge of the public safety allocation. After this reallocation, the A Block would consist of 1.5 MHz of paired spectrum and would be subject to the same rules as the Upper 700 MHz C and D Blocks.

The result of these steps – the Broadband Optimization Plan – is illustrated in Figure 2. Before turning to a brief description of the advantages of this plan, one additional observation is important to understand later discussions in this report. As shown in Figure 2, the BOP results in a downward (in frequency) shift of 1 MHz in the upper Public Safety segment. This has two effects. One, it means that 1 MHz of the paired 6 MHz of narrowband spectrum would reside in UHF television channels 63 and 68 with the balance residing in channels 64 and 69.<sup>1</sup> Two, it creates two 1 MHz segments at the upper edge of UHF television channels 64 and 69<sup>1</sup>. While

<sup>1</sup> The TWG notes that Motorola has suggested in an *ex parte* filing on October 4, 2006 that the critical infrastructure industry be allowed access to this spectrum.



these two segments are both allocated to public safety under the BOP and could be paired for normal narrowband usage employing repeaters and/or Frequency Division Duplexing (“FDD”), the lower of the two segments would be of limited availability because it – or a portion of it – would be needed to provide separation (i.e., a guard band) between narrowband public safety systems and the commercial broadband systems in the C Block.<sup>2</sup> The upper of the two segments abuts narrowband systems on both sides (i.e., 700 MHz public safety narrowband channels below 805 MHz and rebanded National Public Safety Advisory Committee (“NPSAC”) narrowband channels above 806 MHz) and would be available to public safety for unpaired narrowband usage such as direct communications between handheld radios, vehicular repeaters, or secondary fixed RF links. In addition to the guard band provided by the lower of these two 1 MHz segments, two additional 1 MHz segments would be available for providing internal guard bands for separating public safety narrowband/wideband from public safety broadband usage as discussed earlier. These three internal guard band segments and the 1 MHz of unpaired narrowband spectrum are reflected in the illustration in Figure 2.

#### Advantages of the Broadband Optimization Plan

As noted at the outset, the BOP was designed to advance a number of important, long term Commission goals including promoting and improving public safety communications, facilitating the rollout of broadband communications across the country, and increasing the efficiency with which the increasingly scarce spectrum resource is utilized. With regard to the first, promoting and improving public safety communications, the BOP would (a) enable a broader array of broadband technologies by increasing the amount of contiguous usable spectrum available for broadband systems from 4 MHz (paired) to 5.5 MHz (paired), (b) increase the broadband/wideband capacity of public safety systems while maintaining the narrowband voice allocation, (c) facilitate the possibility of public safety/commercial broadband partnerships by locating the expanded commercial spectrum immediately adjacent to the public safety broadband/wideband segments, and (d) give public safety greater control over the required guard

<sup>2</sup> The TWG believes that, with proper engineering, the guard band could be used for limited applications as indicated. For instance, public safety entities could accept the risk of interference in situations where they can control signal levels into end-user radios and/or control the location of nearby broadband cell sites. A prison complex that uses onsite repeaters and has control over the surrounding land is an example of such a situation. By controlling the surrounding land, the agency could ensure that a broadband cell site is far enough away to prevent interference with the prison’s public safety communications system.

bands. With regard to the last point, under the BOP, the internal public safety guard band between the broadband and narrowband/wideband allocations also may be used for any of the narrowband/wideband/broadband applications, just not simultaneously in the same area. In other words, the need for a guard band between public safety allocations can be mitigated through proper frequency coordination techniques and, over time, with improvements in filter technology.

In terms of the second goal, facilitating the rollout of broadband services across the country, the BOP would increase the usable spectrum in both the public safety and commercial allocations by 3 MHz.

In terms of the third goal, increasing spectrum efficiency, the BOP would significantly increase potential spectrum utilization by (a) diminishing the amount of spectrum dedicated to guard bands from 10 MHz to 3 MHz, (b) allowing flexibility in the size/use of these guard bands as described above, while, at the same time, (c) improving the utilization of the A and B Block spectrum. These improvements in spectrum efficiency are particularly important because of the desirable radio propagation characteristics of the 700 MHz region in both public safety and commercial applications.

As described before, while these potential long-term benefits of the BOP were widely recognized and led to widespread support for consideration of the plan, shorter term concerns were raised in three principal areas. The first area of concern related to the amount of time used for consideration of the plan by the Commission. That period is largely beyond the control of the stakeholders in the proceeding and will not be dealt with further in this report. The latter two concerns, which the Technical Working Group dealt with in detail, are discussed in the two sections that follow.

### **3. Migration of Currently Deployed Radios/Systems**

#### **Background**

The consolidation of the narrowband spectrum at the top or upper end of the public safety allocation in the Upper 700 MHz band has potentially significant implications for public safety systems that are currently deployed in the band. The major concerns, as expressed in the public comments on the BOP, centered on the cost of changing deployed systems to enable them to operate on the relocated narrowband channels. Deployed systems consist of two interdependent parts: (1) the infrastructure comprised of such elements as base station transceivers, combiners, transmission lines, towers, antennas, remote receivers, and associated fixed equipment and (2) the mobile/portable radio units used by personnel in the field to access the infrastructure.

At one extreme, changing the base station and mobile/portable unit transceivers to operate on the relocated channels could require the replacement of the units with redesigned equipment. At the other extreme, only simple software reprogramming of deployed radio transceivers would be required and, in the best case, in terms of the mobile/portable units, this could be accomplished “over-the-air” without having to physically “touch” the equipment. Fortunately, as we will discuss in more detail below, modern public safety radio transceivers are typically designed to operate over a wider frequency range and can be reprogrammed to

accomplish such operation with minimal effort.<sup>3</sup> Indeed, early in its deliberations, the TWG concluded that there were no inherent technical impediments to implementing the BOP on currently deployed radios.

Another related factor that bears upon the migration issue is that many public safety systems/radios being sold today are capable of operating in both the 700 MHz band and the adjacent 800 MHz public safety band. Estimates from vendors and public safety officials put the number of 700 MHz capable radios that are currently deployed (many as dual 800/700 MHz radios) at between 550,000 and 600,000. The number of radios actually operating in the 700 MHz band is estimated at being less (and probably much less) than 10,000. Thus, for the portables/mobiles that have been deployed, three conditions can exist:

- (a) The radio has been deployed as part of a 700 MHz system and has already been programmed to operate on both day-to-day operational channels and on the special channels that have been set aside for intersystem interoperability (“I/O”) purposes – all within the 700 MHz band. These radios must be reprogrammed to operate within the revised arrangement within the 700 MHz public safety allocation.
- (b) The radio has been deployed as part of an 800 MHz system but has also been programmed for operation on the special I/O channels within the existing 700 MHz allocation as described in (a). These radios must also be reprogrammed to reflect the shift of the narrowband spectrum (and, hence, the special I/O channels) within the 700 MHz allocation.
- (c) The radio has been deployed as part of an 800 MHz system, is also capable of operating in the 700 MHz band (e.g., on the special I/O channels), but the 700 MHz capability is dormant. That is, the radio has been programmed for operation within the 800 MHz band but not in the 700 MHz band. This situation could arise in locations where the 700 MHz band is still encumbered by a UHF television station.

As we will discuss in more detail in the next subsection, which of these conditions exist has implications for the ease and cost of the reprogramming. One primary concern was the possibility that all radios capable of 700 MHz operations were enabled for operating on the narrowband I/O channels at the point of manufacture.

Another factor which bears upon the migration issue relates to how the reprogramming is accomplished. Depending upon the equipment design, there are three fundamental ways of reprogramming a radio. First, the radio may require physical modifications. This is the method that is typically associated with the situation where the reprogramming must be done in “firmware.” Second, the radio can be attached to a device (e.g., a personal computer) via a cable and its software reprogrammed via the direct link. Third, it can be reprogrammed “over the air”

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<sup>3</sup> In the case of infrastructure equipment and vehicular repeater units, manual retuning of certain analog filters may be required. The cost of manual retuning or, in limited cases, the replacement of such filters is addressed later.

if the radio is designed with such a feature. Once again, which of these three situations exist has implications for the ease and cost of reprogramming radios that have been deployed.

Finally, the costs of reprogramming the radios to operate within the revised 700 MHz public safety allocation can be divided into two components: (a) the one-time or non-recurring costs of developing and testing the required software and (b) the costs of actually installing the required software in the radios either through a physical connection or “over-the-air” as described earlier. With this background, we now turn to an analysis of costs associated with modifying deployed systems to enable them to operate on the relocated narrowband channels under the BOP. The TWG recognizes that proponents of the BOP have stated that public safety entities should not bear the costs caused by implementation of the BOP.<sup>4</sup>

### Analysis

In the analysis which follows, we will examine the migration costs associated with each major category identified above: infrastructure, 700 MHz-only radios, 700/800 MHz radios, and 800 MHz radios with 700 MHz capabilities dormant. The results of the TWG analysis for each of the four categories of deployed equipment are provided below:

**Deployed Infrastructure:** A search of the Commission’s Universal Licensing System (“ULS”) data base reveals that only 26 transmission towers have been registered as of May 2006. Moreover, there is no need to replace existing equipment to handle the migration to the relocated narrowband channels. This means that the costs associated with accomplishing the migration are simply the non-recurring and recurring (per transceiver) cost of reprogramming the base station radios at 26 accessible sites. The actions required to shift the base stations would be comparable to those required for any system deployment. These actions include (a) Regional Planning Committee (“RPC”) approvals, frequency coordination, and licensing changes and (b) technician time to tune site cavity filters and other analog components to new frequencies.<sup>5</sup> Given the small number of sites and the relatively nominal effort associated with reprogramming the base station radios, especially in light of the other major benefits of the migration, the TWG found that these costs should not deter the adoption of the more effective and efficient BOP plan.<sup>6</sup>

**Deployed and Operational 700 MHz Radios:** Of the 550-600,000 deployed radios that operate on a combination of 800 MHz and 700 MHz or only on 700 MHz, the TWG found that fewer (and possibly many fewer) than 10,000 of these mobile/portable radios are operational in the

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<sup>4</sup> Comments of Access Spectrum, LLC and Pegasus Communications Corp., WT Docket Nos. 06-169 and 96-86 (Oct. 23, 2006).

<sup>5</sup> The TWG recognizes that, in a limited number of cases, actual hardware costs may be incurred. These could include the cost of replacing some analog combiners (transmit and receive filters) or the cost of acquiring spare units that might be required if factory retuning of combiners is necessary in deployed public safety infrastructure.

<sup>6</sup> During the deliberations of the TWG, it was learned that the ULS data base is likely to show only site-licensed systems operating on “General Use” channels. (The different categories of channels are identified in Section 4.) This means, for example, that public safety systems implemented on “State” channels, which are licensed on a geographical area basis (i.e., area-licensed), would not appear in the ULS. Some local public safety agencies may also be operating on State channels on a temporary basis under various arrangements. Because of the limited number and exceptional circumstances associated with such cases, the TWG concluded that this additional information did not change the stated finding.

field at 700 MHz. The number is much smaller than originally estimated since the narrowband I/O channels were not enabled at time of manufacture.

Both Motorola and M/A-COM indicated with a very high degree of confidence that these mobile/portables can operate on frequencies consistent with the BOP with no changes in hardware or firmware. The TWG also took note of the fact that many of these radios can be reprogrammed over-the-air which minimizes the recurring or per-radio costs of making any change. Finally, the TWG estimated the recurring costs of reprogramming the remaining radios – *i.e.*, the radios in the two categories that must be “touched” to reprogram them – would be nominal, no more than \$100 per radio. Given these informed estimates and given the other public interest benefits, the TWG found that these costs should not deter the adoption of the more effective and efficient BOP plan.

**Deployed and Non-Operational 700 MHz Radios:** The TWG noted estimates as high as 600,000 for the number of deployed 800/700 MHz radios with the 700 MHz capabilities dormant. The TWG went on to find, however, that these radios would have to be programmed to operate on 700 MHz in any case. That is, they would have to be programmed to operate on 700 MHz under the original plan or under the more effective and efficient BOP. Thus, the TWG found that no incremental costs attributable to the BOP plan that would be incurred in programming these radios since any non-recurring costs would be absorbed under the second and third categories described in the paragraphs immediately above.

Based upon the above analysis, the TWG concluded that the cost of changing deployed systems to enable them to operate on the relocated narrowband channels should not stand in the way of adoption of the BOP as long as the individual agencies that have deployed Upper 700 MHz public safety systems do not bear the comparatively minor costs of making the required changes to their systems.

#### **4. Implementation in the Canadian Border Region and Impact on Currently Planned Deployments**

##### Background

Because radio waves do not respect political boundaries, the use of the Upper 700 MHz band must be coordinated with Canada. In other words, a change in allocations/assignments on one side of the border may have impact on allocations/assignments on the other side. Currently the required coordination along the common border is governed by a formal agreement between the FCC and Industry Canada. This U.S.-Canada Border Agreement (“Border Agreement”) seeks to minimize harmful interference across the border and, where interference cannot be avoided, to apportion the available spectrum/channels between the two countries in a way that is fair and reflects the relative needs of each country.

Five specific issues have been raised regarding possible interaction between the adoption of the BOP and its implementation in the region covered or impacted by the Border Agreement. In brief, the specific issues include concerns about (1) the possible impact on a request by the State of New York (“New York State”) that the Commission waive certain of its rules so that the

state can implement a new 700 MHz public safety communications system in the greater New York City metropolitan area (“Downstate New York”), (2) the possible impact on current and planned deployments of state public safety systems in border areas, (3) the possible impact on certain narrowband I/O and statewide channels described below, (4) the possible impact on the apportionment of general use channels between Canada and the United States, and (5) the need for, and terms of, renegotiating the existing Border Agreement because of the changes associated with implementing the BOP.

Digressing briefly, in the Upper 700 MHz public safety spectrum, the United States established five categories or types of channels (in addition to General Use narrowband channels). The five categories are: Type 1 narrowband I/O channels mentioned immediately above, Type 2 narrowband reserve channels, Type 3 narrowband low power channels, Type 4 narrowband itinerant low power channels, and Type 5, narrowband state channels. Canada does not have the reserve (Type 2) and state (Type 5) categories and thus it treats Type 2 and Type 5 as General Use Narrowband Channels.

Five other pieces of background information may be useful in understanding the discussion of each of five areas of possible concern enumerated above:

*First*, Canada currently has no plans to reallocate TV channels 64 and 69 from television broadcasting to public safety or other land mobile radio use though the United States’ adoption of the BOP may provide additional incentive for Canada to do so. Thus U.S. public safety operations will continue to be precluded from operation in the associated frequency ranges in the border areas. Or, stated in the alternative, public safety agencies will only have access to TV channels 63 and 68 on the U.S. side of the border along the boundary.

*Second*, for spectrum planning purposes using the Border Agreement, the area along the border is divided into three zones, Zones I, II and III, reflecting the location of major population centers and varying population densities on either side of the boundary. These zones are further divided into Sectors. (See Figure 5 on page 19 of this report for a diagram as to the locations of Zones I and II; Zone III includes the Alaskan border with Canada.)

*Third*, certain of the Upper 700 MHz public safety channels are designated as I/O, statewide and general use channels as described above. The TWG concluded that it was desirable to have as many I/O (Type 1) and statewide (Type 5) channels as possible be accommodated in the 1 MHz of paired narrowband spectrum that remains in TV channels 63 and 68 after implementation of the BOP. Otherwise, if there were no allotments for these uses in TV channel 63 and 68, the border region would have different I/O channels than the rest of country and, in terms of a statewide system, different statewide channels. Accommodating these important channels in TV channels 63 and 68 would also facilitate interoperability between U.S. and Canadian public safety entities in times of emergency. If the I/O and statewide channels were within TV channels 64 and 69, they could not be used in the border area because they would cause interference to, and incur interference from Canadian television broadcasting that remains on those two channels.

*Fourth*, similarly, one narrowband channel pair is required as a common “Calling Channel.” It must also be accommodated within the same 1 MHz of spectrum that remains in TV channels 63 and 68. Currently the four narrowband interoperable calling channel pairs are designated in 39/40<sup>7</sup> and 681/682 in the lower segment (TV channel 63 and 64).

*Fifth*, and finally, depending upon the zone, the portion of the general use channels allotted to Canada versus the United States varies from roughly 15 – 85 percent (CA-US), respectively, to 70 – 30 percent (CA-US). It is desirable that the flexibility to maintain these proportions in each zone be retained to ease the discussions with Canada regarding modifications to the Border Agreement.

#### Impact on New York State Waiver Request

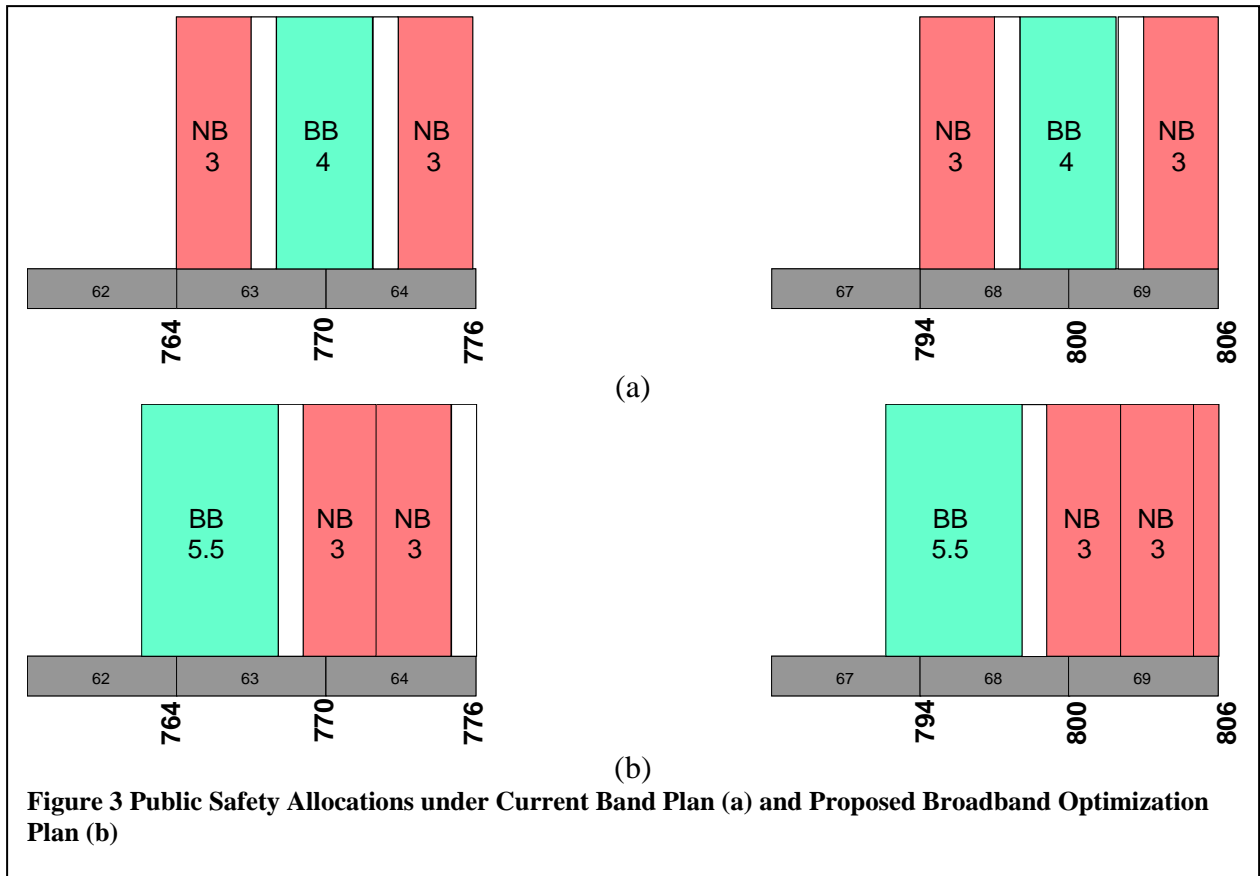
As noted before, concerns were expressed about the possible impact of the BOP on a request by the State of New York that the Commission waive certain of its rules so that it can implement a new 700 MHz public safety communications system in Downstate New York prior to the digital television transition. For reference, the current and proposed public safety allocation in the Upper 700 MHz band is shown in Figure 3. Under the waiver, the New York State system in Downstate New York would be implemented between 774 MHz and 776 MHz in the TV Channel 64 portion of the current public safety allocation. As shown in Figure 3(a), that portion is currently designated for narrowband systems. As shown in Figure 3(b), under the BOP, all but the upper 1 MHz of spectrum in TV Channel 64 would be designated for narrowband systems. The TWG agreed that future deployments of the New York State system in Downstate New York could be shifted directly to the 773 – 775 MHz range with negligible impact on the rollout of that system. In particular, since the assignments would be shifted as a group without changing their relative positions, there should be no impact on the planning and coordination (*e.g.*, for co-channel and adjacent channel operations) that has already been accomplished in conjunction with the New York State system. Moreover, the TWG believes that the 1 MHz downward shift in the narrowband spectrum as proposed in the BOP would have little impact on the TV interference analysis that New York State submitted to the FCC in conjunction with the waiver request. The TWG reached this conclusion based upon its observations that (a) there is now a date certain for the Digital Television (“DTV”) transition and that deadline is fast approaching, (b) the State was conservative in its analyses, and (c) the only TV station that had caused the State to impose frequency offset limitations on a subset of the waiver sites has now petitioned the Commission to early flash-cut to DTV-only operations on its in-core channel allotment.

#### Public Safety Systems in the Border States

The greatest challenges created by the proposed changes to the current Upper 700 MHz public safety allocation are associated with potential incompatibilities with current and planned deployments of public safety systems along the border between the U.S. and Canada. It is the

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<sup>7</sup> There are 1,920 channel assignments of 6.25 kHz each for the current Upper 700 MHz Public Safety bands. This is the entirety of the two 6 MHz blocks of narrowband allocation. They are arranged in numerical order with the lowest channel number starting for the current channel plan at 764 MHz, channel 481 starting at 773 MHz, channel 961 starting at 794 MHz, and channel 1441 starting at 803 MHz.



understanding of the TWG that the New York system is the only such system currently being deployed along the border. It is the TWG's further understanding that Ohio and Michigan are working on 800 MHz systems only (rather than 700 MHz systems) at this point in time. However, this is likely to change in the future and states like Ohio, Pennsylvania, Michigan, and Washington may deploy systems in the Upper 700 MHz band. In its deliberations, the TWG focused on the impact of the BOP on the planned New York State deployment because it provided a convenient, current example of the changes or adjustments that would be necessary to accommodate the proposed changes to the Upper 700 MHz band in the border areas. The TWG is confident, however, that the analyses and recommendations provided below are directly applicable to all the border states, including those along not only the border with Canada, but with Mexico as well.

### Analysis

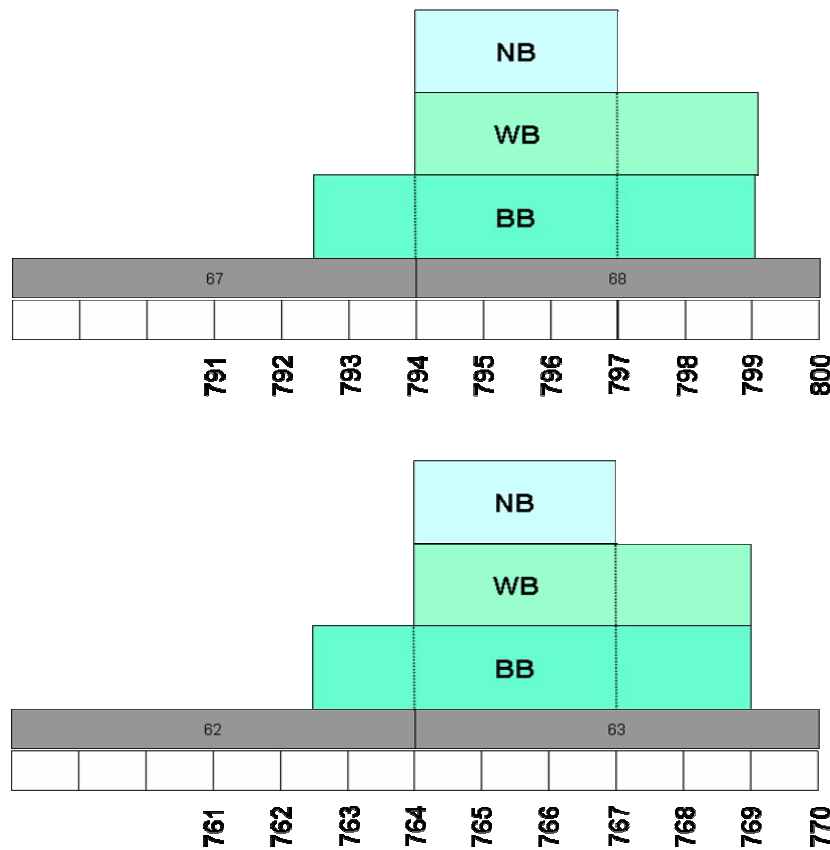
Parts of the New York State public safety system being deployed on a statewide basis reside within the current narrowband portions of the existing allocation in TV Channels 63 and 68. Specifically they would reside between 764 – 766 MHz and between 794 – 796 MHz (this is paired spectrum). After adoption of the BOP, these deployed narrowband channels would reside within the portion of the public safety allocations that have been set aside for broadband/wideband systems under the proposed plan. (See Figure 3, above.)

After extensive analyses, the TWG concluded that this potential conflict could readily be mitigated in either or both of two ways. *First*, the deployed systems could be accommodated

within the 1 MHz paired portion of the narrowband spectrum that remains within TV channels 63 and 68 under the BOP (*i.e.*, 769 – 770 MHz paired with 799 – 800 MHz). That would eliminate any potential interference issues between narrowband and broadband systems. *Second*, with a further change in the Commission's rules, the currently deployed narrowband systems could remain, but subject to appropriate interference coordination and Regional Planning Committee approval. This would provide New York State (and all other border states) with the option of designing their own solution by giving them greater flexibility to deploy narrowband, wideband, and broadband throughout the public safety allocation, rather than confining them to certain frequencies for each. For interoperability purposes, New York State could use the narrowband I/O channels that would be defined in 769 – 770 MHz paired with 799 – 800 MHz. This also means that New York State could deploy, subject to some constraints elaborated upon below, a mixture of narrowband, wideband and/or broadband channels throughout the public safety allocation, rather than confining them to certain frequencies as is the case today. They could deploy more in the future after Canada clears Channels 64 and 69.

Some constraints should be imposed upon the increased flexibility to operate narrowband, wideband, and broadband within the 762.5 – 769 MHz and 792.5 – 799 MHz blocks to reflect current radio capabilities and border area restrictions. As shown in Figure 4, it is the TWG's belief that narrowband systems should be restricted to the 764 – 767 MHz and 794 – 797 MHz blocks – a restriction which is consistent with the current narrowband allocations. Wideband operations should be permissible in the entire allocation within Channels 63 and 68 which includes 764 – 769 MHz and 794 – 799 MHz. Finally, broadband operations should be permissible across the entire paired block except between 768 – 769 and 798 – 799 MHz if such a guard band is desired by public safety.

In order to successfully implement this greater degree of flexibility, specific interference coordination methods and procedures must be developed for use by the RPCs and frequency coordinators. The needed technical rules are briefly discussed in the subsection which follows.



**Figure 4 Details of Flexible Allocation within the lower BB/WB/NB segment (bottom) and upper segment (top).**

### Technical Rules

At the time of this report, the TWG concluded that the specific values for the rules associated with the flexible allocation in the 762.5 – 769 MHz and 792.5 – 799 MHz bands could not be established. Establishing specific values for certain key parameters needed in the interference analysis requires analysis to determine the impact of various broadband waveforms and specific deployment architectures. It is the TWG’s understanding that the required analyses are currently being undertaken by vendors of broadband equipment, including Qualcomm/Lucent (EvDO), Qualcomm (Flash-OFDM), and WiMAX (OFDM) producers. It is intended that the results of these analyses will be published in a separate report to be made available by the end-of-the-year 2006.

Although determining specific values for key interference parameters must necessarily wait upon further laboratory and other analyses, certain general recommendations can be made at this time. For example, narrowband assignments should not be made below 764 MHz for the lower segment and 794 MHz for the upper segment of the public safety allocation to conform with the currently deployed dual-band 800/700 MHz radios which can easily accommodate narrowband channels from 764 – 776/794 – 806 MHz and to ensure adequate interference

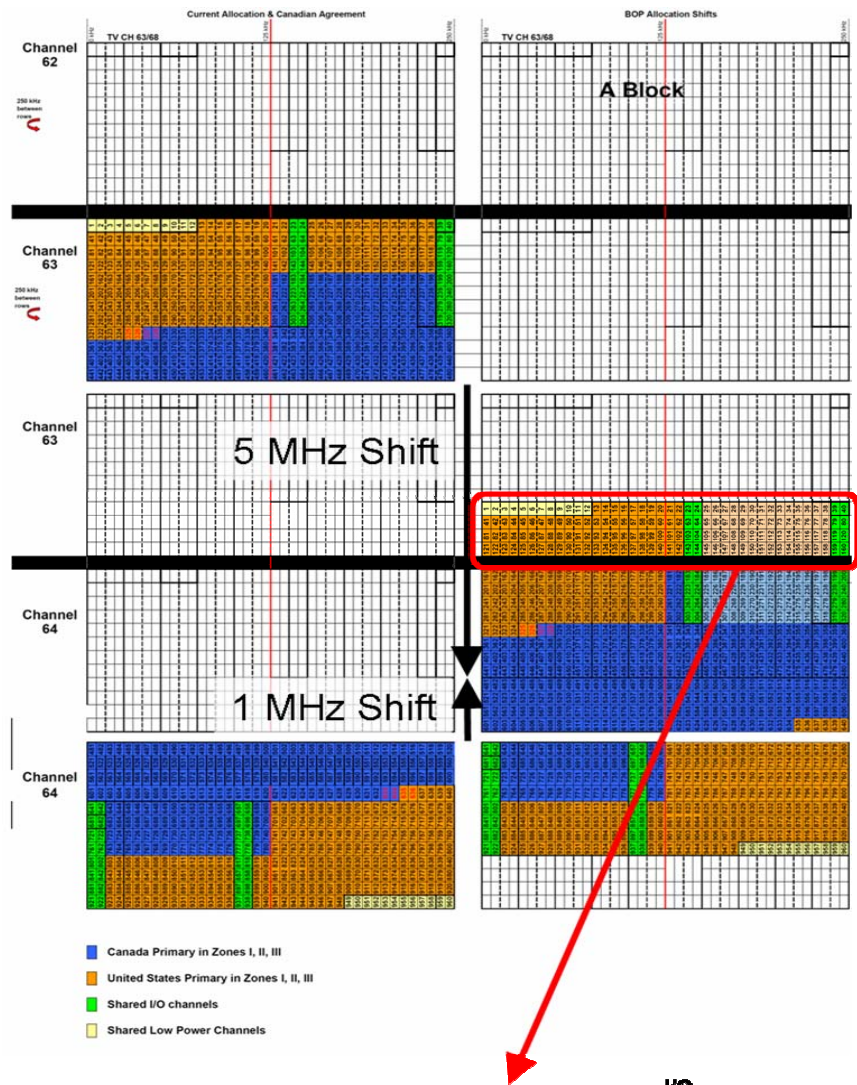
protection from the adjacent broadband commercial bands. This is consistent with the current narrowband allocation and thus should not require any modifications to current channel plans. The TWG is committed to working with NPSTC and other stakeholders to find a single consolidated position on these rules.

### Interoperability Channels

As observed earlier, the TWG concluded it was desirable to have as many I/O (Type 1) and statewide (Type 5) channels as possible be accommodated in the 1 MHz of narrowband spectrum that remains in TV channels 63 and 68 after implementation of the BOP. In order to find out how well this objective had been met, the TWG undertook a brief analysis to determine how many of the different types of channels would remain in TV channels 63 and 68 after the narrowband channels were relocated to implement the BOP. The results of the analysis are displayed in Table 1 showing the simple 5 MHz shift upward of the lower 3 MHz of paired narrowband spectrum. Using the table, it can be determined that, after implementing the BOP, in TV channels 63 and 68 (this comparison is to the number of channels originally in TV channels 63 and 68):

- 16 of 32 Type 1 paired channels remain (narrowband interoperability channels) for the U.S. allocation
- 4 of 8 Type 2 paired channels remain (narrowband reserve channels) (Note that in Canada, these are General Use channels)
- 8 of 16 Type 3 paired channels remain (narrowband low power channels)
- 4 of 8 Type 4 paired channels remain (narrowband itinerant low power channels)
- 48 of 96 Type 5 paired channels remain (narrowband statewide channels) (Note that in Canada these are also General Use channels)

Based upon this brief analysis, the TWG concluded that an adequate number of Type 1 I/O channels (16 x 6.25 kHz) and Type 5 statewide channels (48 x 6.25 kHz) would remain in both TV channels 63 and 68 to support both national and statewide interoperability requirements in the areas near the U.S.-Canadian border. In short, the TWG concluded that this objective had been met. The TWG also concluded that the required common Calling Channel could be accommodated within the same 1 MHz of spectrum.



NB Low Power										General Use										I/O									
121	81	41	1							141	101	61	21							161	121	81	41						
122	82	42	2							142	102	62	22							162	122	82	42						
123	83	43	3							143	103	63	23							163	123	83	43						
124	84	44	4							144	104	64	24							164	124	84	44						
125	85	45	5							145	105	65	25							165	125	85	45						
126	86	46	6							146	106	66	26							166	126	86	46						
127	87	47	7							147	107	67	27							167	127	87	47						
128	88	48	8							148	108	68	28							168	128	88	48						
129	89	49	9							149	109	69	29							169	129	89	49						
130	90	50	10							150	110	70	30							170	130	90	50						
131	91	51	11							151	111	71	31							171	131	91	51						
132	92	52	12							152	112	72	32							172	132	92	52						
133	93	53	13							153	113	73	33							173	133	93	53						
134	94	54	14							154	114	74	34							174	134	94	54						
135	95	55	15							155	115	75	35							175	135	95	55						
136	96	56	16							156	116	76	36							176	136	96	56						
137	97	57	17							157	117	77	37							177	137	97	57						
138	98	58	18							158	118	78	38							178	138	98	58						
139	99	59	19							159	119	79	39							179	139	99	59						
140	100	60	20							160	120	80	40							180	140	100	60						

Table 1 Channel Assignments in 1 MHz of NB Channels remaining in Channel 63 after 5 MHz shift in frequency

### Apportionment of Channels between Canada and the United States

As explained earlier, depending upon which of three zones is being examined, the portion of the general use channels allotted to Canada versus the U.S. varies widely from a 85-15 US-CA split to a 70 – 30 CA-US split respectively. Concerns were expressed about whether these proportions could be maintained in the respective zones after the changes contemplated by the

BOP were implemented and the Border Agreement was renegotiated. In order to address this concern, the TWG undertook an analysis of the situation that would be created by the BOP changes.

Table 2 displays the initial step in the analysis. The left-hand column illustrates the current public safety allocation with color-codes indicating the different types of public safety channels and the channels where U.S. and Canadian systems are primary. This table is an example of a 50-50 split for primary channels between the U.S. and Canada. The middle column illustrates the situation after the BOP shifts occur. The right-hand column illustrates the situation after the shifts occur and with the primary allotments between the U.S. (orange) and Canada (blue) left unchanged but with all of general use channels made available for proportioning between the two countries. Channels highlighted in green indicate the narrowband interoperability (I/O) channels. The lightly shaded regions between the narrowband I/O channels are the narrowband channels for statewide communications. The channels highlighted in yellow are the low power channels. Each row within a column denotes forty 6.25 kHz channels or a total of 250 kHz. Note that the 5.5 MHz paired spectrum that is available for broadband/wideband systems under the BOP is included in the table.

Table 3 displays the next step in the analysis for Zone 1, Sector 1 where the split is 85-15 between the U.S. and Canada. Note, as shown in the right-hand column, that the Type 1 I/O channels and Type 5 statewide channels would remain available in the U.S. in TV channels 63 and 68 as discussed above. Similarly, Table 4 displays a scenario (Zone 1, Sector 2) in which the narrowband paired general use channels are split on roughly a 70 – 30 percent basis favoring Canada while Table 5 displays the opposite scenario (Zone 1, Sector 1 – Northeast Ohio) where the split is roughly 80 – 20 percent favoring the U.S. Table 5 provides a new channel category (purple shade) for the general use channels that are to be negotiated between Canada and the U.S. Each of the latter three tables (Tables 3 – 5) also illustrates comparable amounts of the broadband/wideband spectrum proportioned between the two countries. It should be emphasized that these tables are for illustrative purposes only and are intended to demonstrate that it is possible to maintain the same proportional split of the general use channels. It should be noted that the amount of spectrum available after the split is greater under the BOP than with the original allocation simply due to the availability of more spectrum. The TWG concluded that this analysis successfully addressed the concerns raised regarding the apportionment of channels between Canada and the United States. Tables 6-8 are the remaining Canadian border cases: Zone 1, Sector 2 – London, Canada; Zone 1 – Maine, United States; and Zone 1, Sector 2 – Vermont and New Hampshire.

### Border Agreement Renegotiation

Regarding the need for, and terms of, renegotiating the existing Border Agreement because of the changes associated with implementing the BOP, the TWG concluded that, as a threshold matter, the agreement would have to be renegotiated irrespective of which proposal the Commission ultimately adopts for introducing broadband technology in the Upper 700 MHz public safety band. This is because the current agreement does not encompass broadband systems which exhibit different interference characteristics compared to narrowband/wideband systems. Thus the only concern that remains relates to whether the BOP would somehow

complicate bi-lateral negotiations with Canada that are necessary in any event. However, because the BOP actually increases the amount of spectrum available for public safety use – *i.e.*, from 12 MHz paired to 13.5 MHz paired – the negotiations should actually be less complicated rather than more complicated. Indeed, the amount of spectrum available for Canada can actually be increased under the BOP if negotiations reveal that need.

## **5. Outreach Efforts**

In terms of outreach efforts, as explained in the introduction of this report, the work of the TWG has been supported by a wide range of stakeholder groups including public safety entities, equipment manufacturers and commercial service providers. In addition to its five in-person and telephonic meetings, members of the TWG have participated in discussions with Canadian public safety and Industry Canada personnel to solicit feedback as to the BOP and the proposed implementation strategies inclusive of border issues. When an early draft of the instant report was available, the TWG informally circulated it among other public safety groups for their reaction. The TWG remains committed to maintaining these outreach efforts in the future.

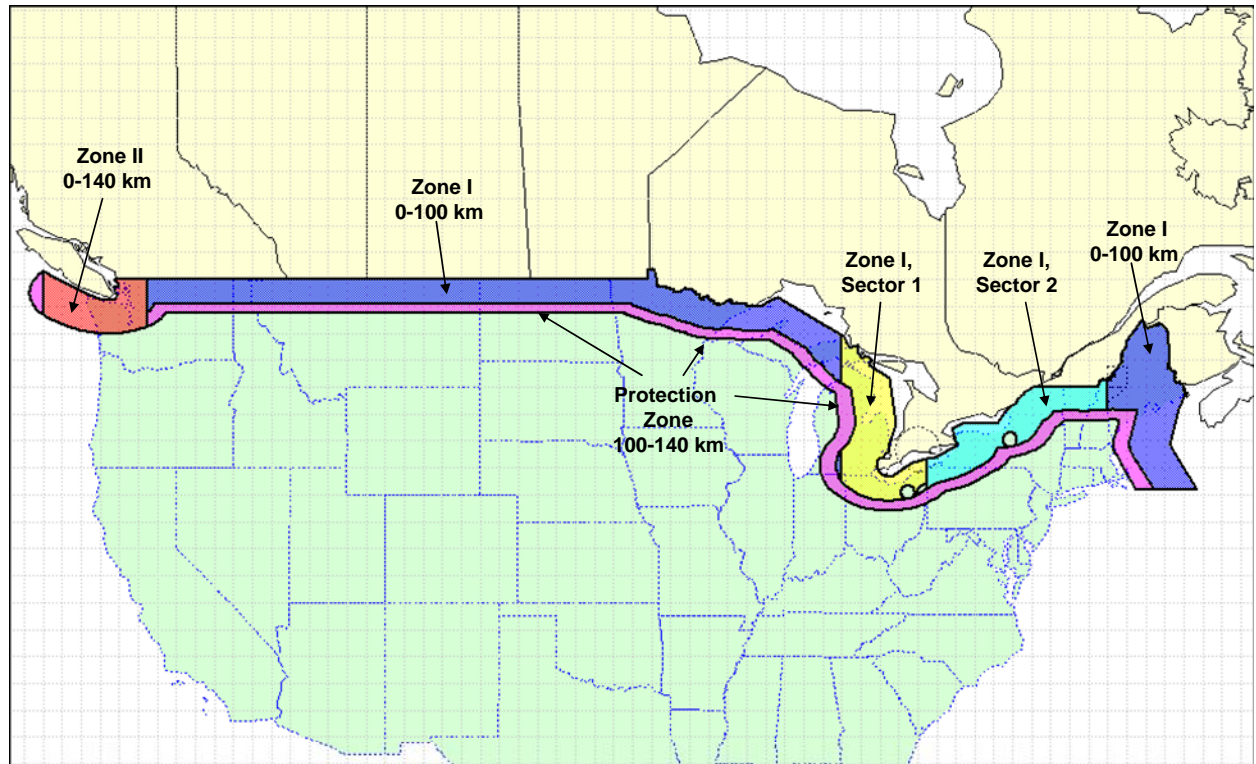
## **6. Summary and Conclusions**

The FCC is considering a number of proposals for accommodating broadband systems in the portion of the Upper 700 MHz band that is currently allocated for public safety use. One such proposal – the Broadband Optimization Plan or BOP – was widely acknowledged as offering important benefits to the various stakeholder groups and achieving important Commission goals. These important goals include promoting and improving public safety communications, facilitating the rollout of broadband communications across the country, and increasing the efficiency with which the increasingly scarce spectrum resource is utilized. Despite the widespread acknowledgement of the potential benefits of the BOP, concerns about the plan were raised in several areas. This report was prepared by an open, voluntary and informal group of public safety technical specialists – the TWG – who assembled to address these concerns.

Based upon the analysis described herein, the TWG concluded that there were no inherent technical impediments to implementing the BOP on currently deployed radios and that the costs of changing deployed systems to enable them to operate on the relocated narrowband channels are modest compared to the potential benefits. Thus, the TWG further concluded that these comparatively minor costs should not stand in the way of adoption of the BOP as long as the individual agencies that have deployed Upper 700 MHz public safety systems do not bear the costs of the changes to their systems caused by the BOP.

The TWG also concluded that concerns raised regarding the implementation of the BOP in states bordering Canada can be readily addressed in a straight-forward way and, hence, should not stand in the way of adopting the BOP with all of its attendant benefits. More specifically, the TWG concluded that (a) the adoption of the BOP would have no adverse impact on the New York State request that the Commission waive certain of its rules to enable a new 700 MHz public safety communications system in Downstate New York prior to the digital television transition, (b) any potential risks to deployed narrowband public safety systems in TV channels

63 and 68 caused by reallocating the spectrum for broadband/wideband use under the BOP could be avoided by either or a combination of two readily implemented approaches, (c) after implementation of the BOP, an adequate number of narrowband interoperability and statewide channels would remain in TV channels 63 and 68 to support both national and statewide interoperability requirements in the areas near the U.S.-Canadian border, (d) the narrowband general use channels available under the BOP could be fairly divided between the United States and Canada in the same proportions that exist under the current agreement, and (e) the existing Border Agreement would have to be renegotiated regardless of the plan adopted to introduce broadband technology into the Upper 700 MHz Band and that, in actuality, the BOP could facilitate the necessary negotiations because it increases the amount of useful spectrum available in the band.



**Figure 5 Reference Map for Border Region Definitions**

Table 2: United States-Canada 700 Sharing Agreement

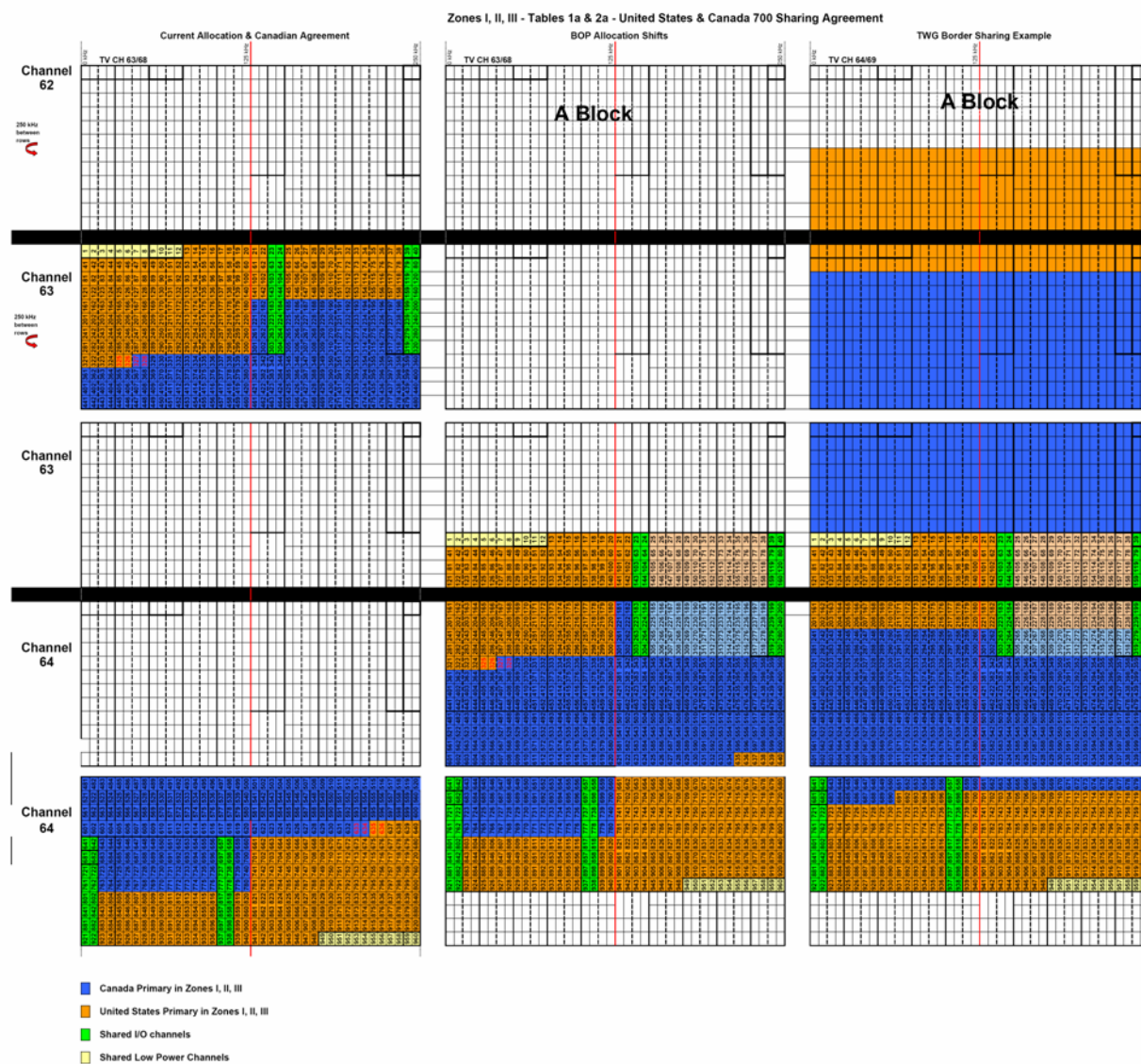


Table 3: United States-Canada 700 Sharing Agreement – Zone 1, Sector 1

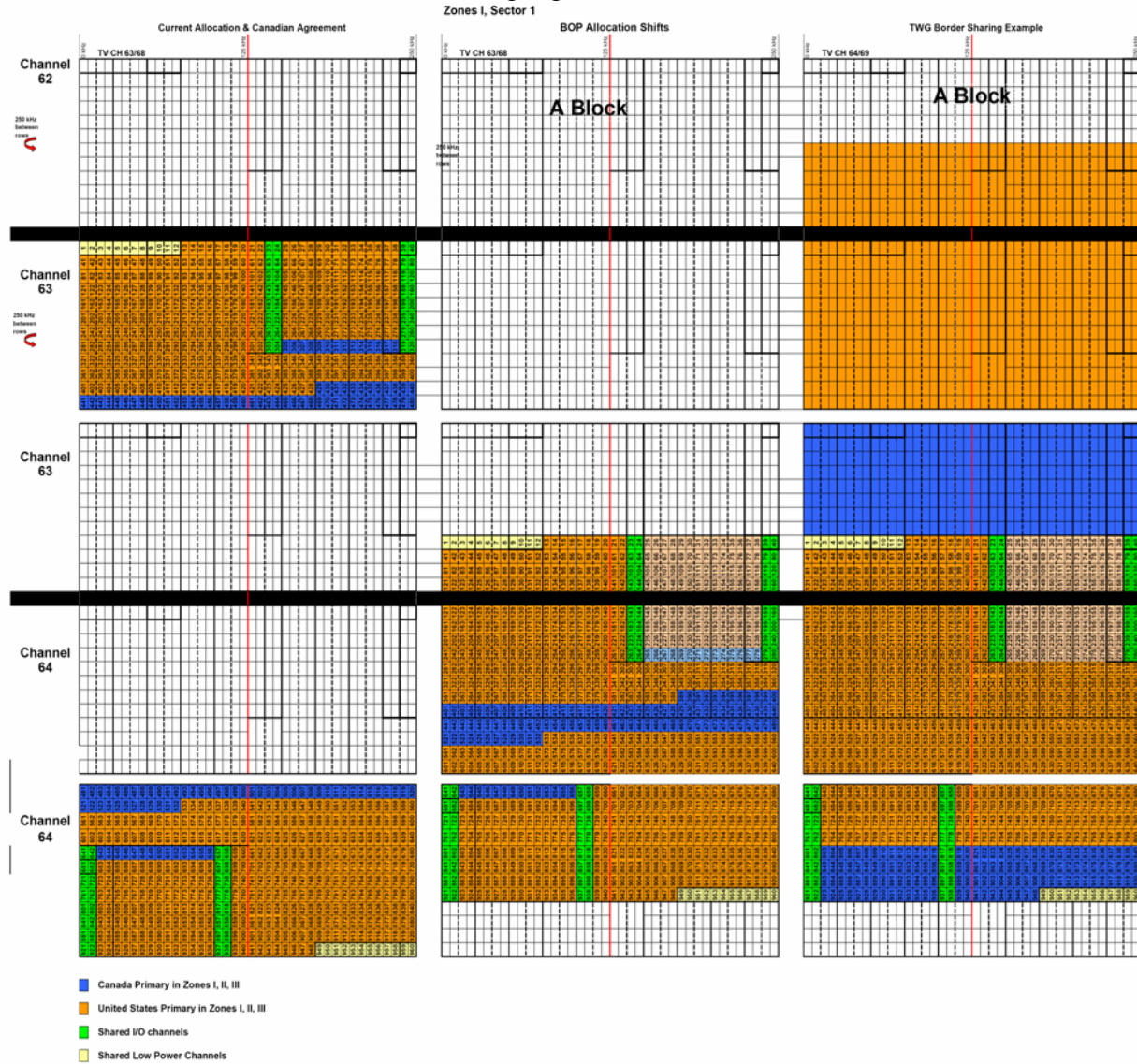


Table 4: United States-Canada 700 Sharing Agreement – Zone 1, Sector 2

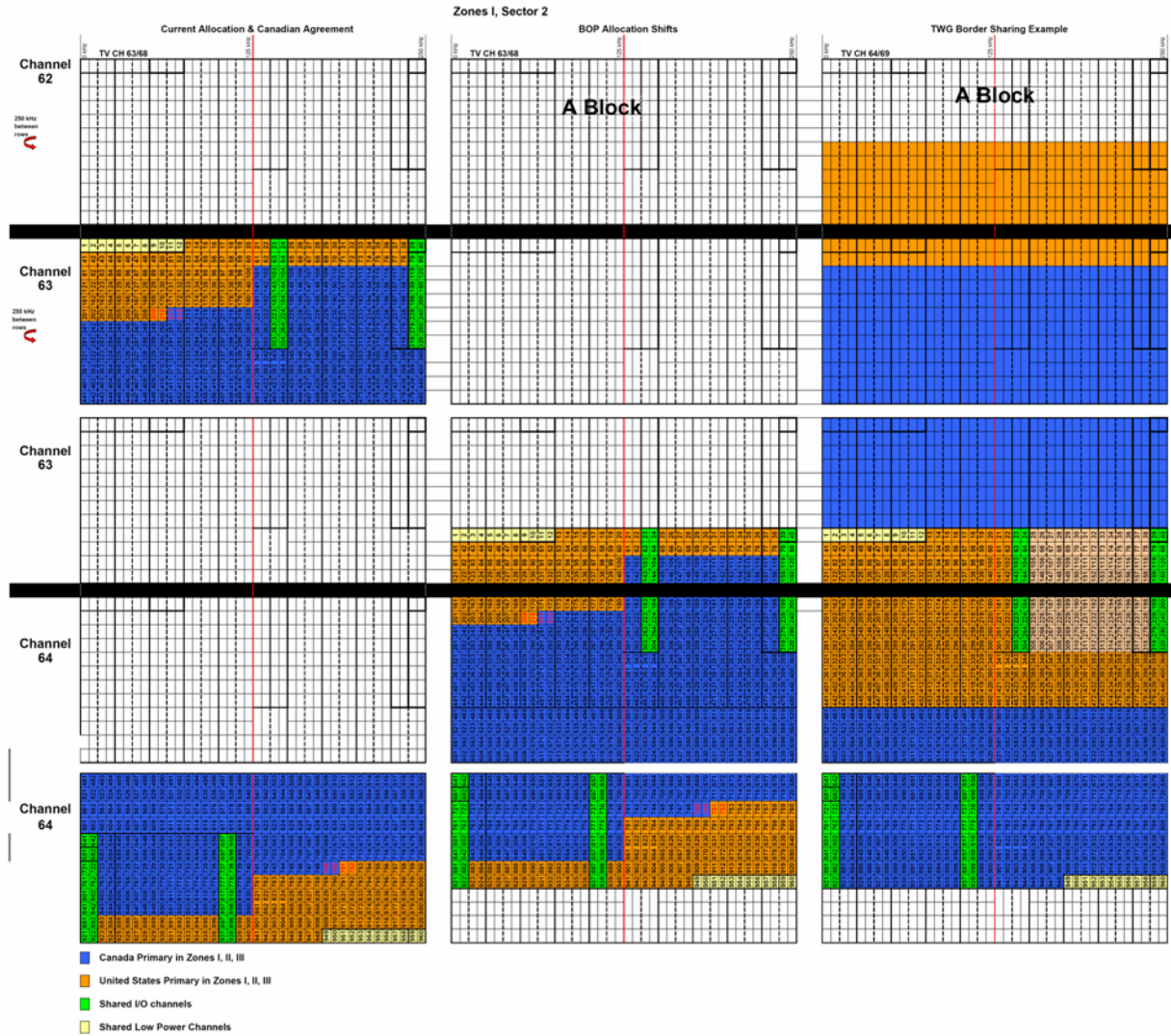


Table 5: United States-Canada 700 Sharing Agreement – Zone 1, Sector 1 – Northeast Ohio

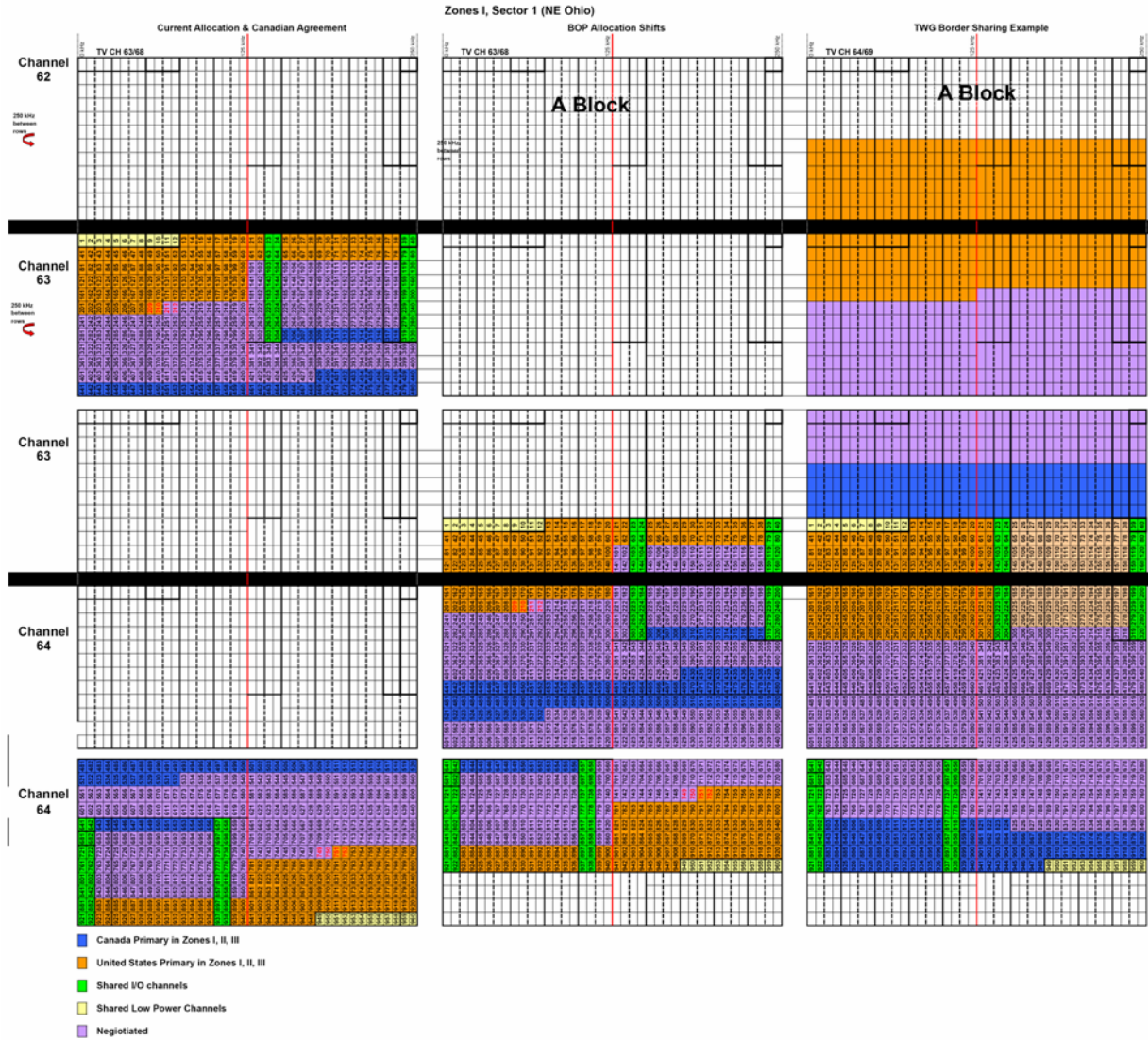


Table 6: United States-Canada 700 Sharing Agreement – Zone 1, Sector 2 – Canada (London)

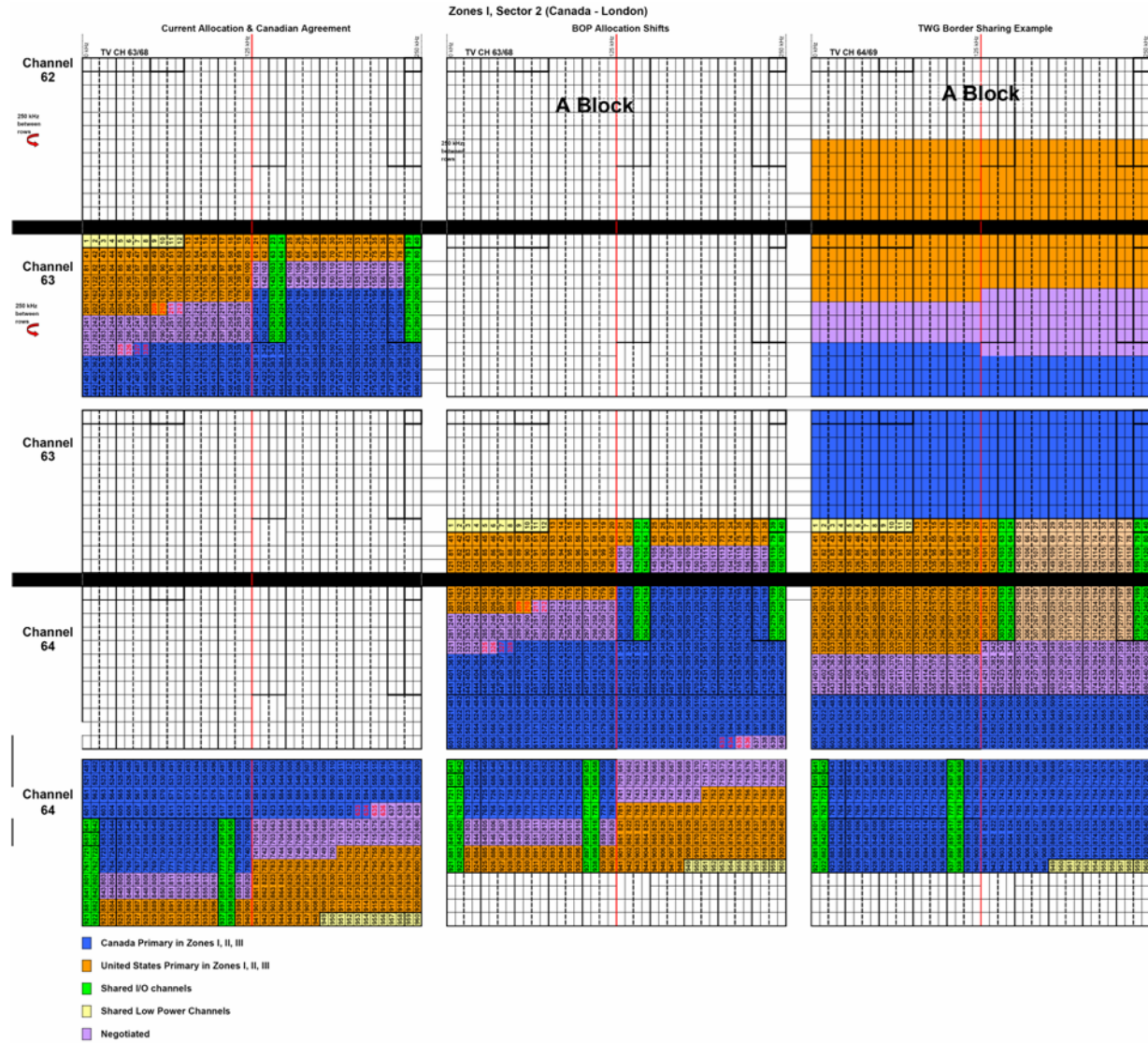


Table 7: United States-Canada 700 Sharing Agreement – Zone 1 – Maine, U.S.

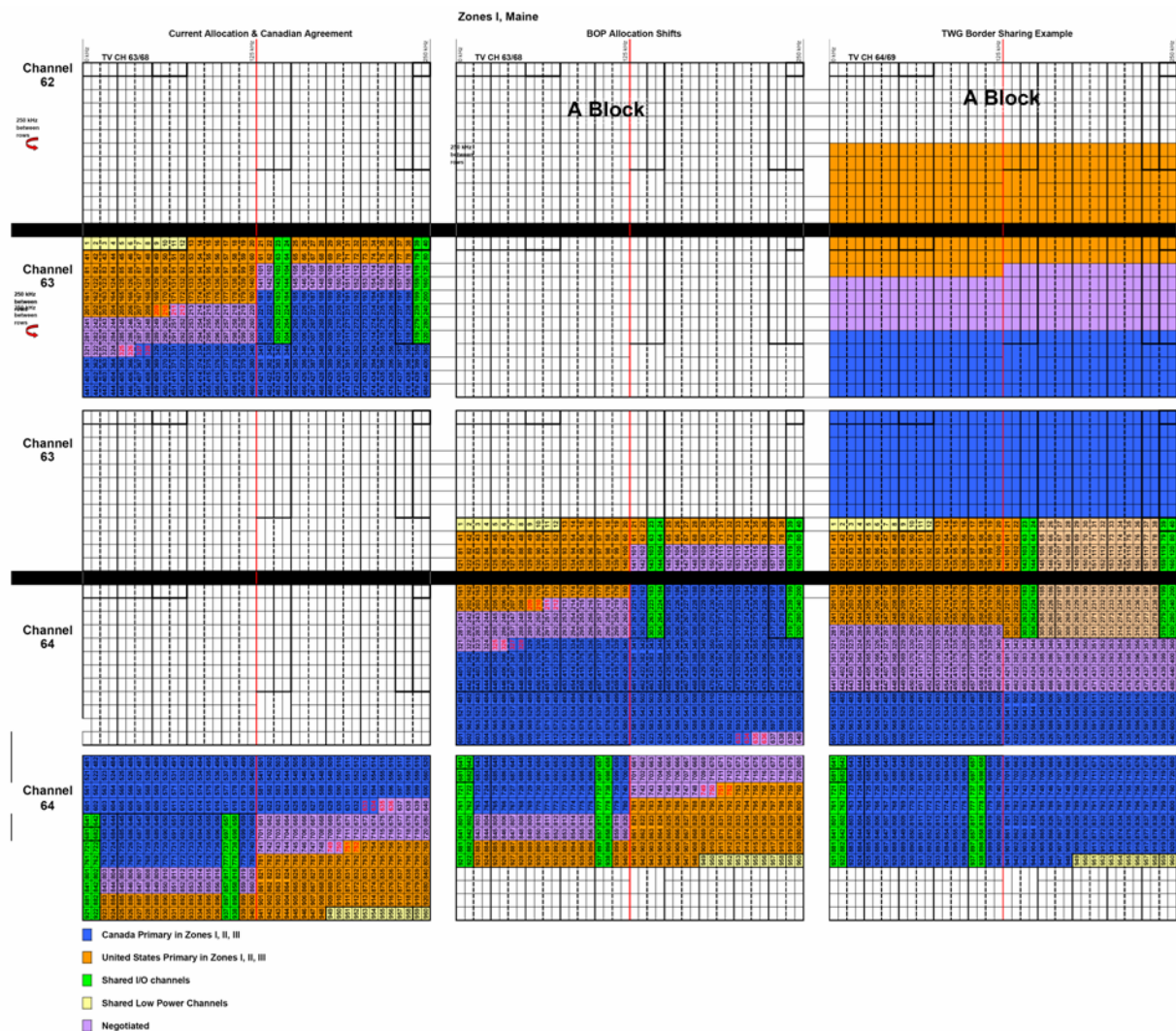


Table 8: United States-Canada 700 Sharing Agreement – Zone 1, Sector 2 – Vermont, New Hampshire

